(f) Total "Conventional" GSO MSS Spectrum

Based on inputs to ITU-R Task Group 8/3 made by Inmarsat, first in the Toronto meeting, July, 1994, and more recently in Geneva, the forecasts for so called "conventional" MSS (ie, non-handheld PC/MSS, most likely provided by GSO satellites) have been revised downward, to take account of the likely cross-impact to certain conventional MSS markets (particularly land mobile services) which would likely migrate to handheld Non-GSO systems when these more convenient services are available towards the end of the century.

Thus, to compare these projections to the ITU-R, Joint International Working Party preparing for WARC-92 (JIWP-92), the JIWP-92 forecast the following spectrum requirements for each direction, in the year 2010, including a speculative value for LMSS which may have included considerable overlap between "conventional"-GSO and handheld non-GSO:

Service	Minimum Requirement (MHz)	Likely Req't (MHz
AMS (R) S	14.5	17.5
Other AMSS	15.0	18.0
LMSS	41.3	87.6
MMSS	17.0	40.0
Distress/Sfty	1.0	1.0
TOTAL	88.8 MHz	164.1 MHz

With the cross-impacts for LMSS factored in, the Inmarsat contributions provided a more realistic forecast for Conventional MSS Spectrum Requirements (excluding PC-MSS) served as a correction to the original JIWP Report:

Service	Lower Bound MSS Non-Handheld (MHz)	Realistic MSS Non-Handheld (MHz)
Aero Total	29.5	35.5
LMSS	13.8	29.2
Maritime	17.0	40.0
Distress/Sfty	1.0	1.0
TOTAL	61.3 MHz	105.7 MHz

The most recent forecasts for conventional MSS have also been truncated to about the year 2005, due to the uncertainties associated with projecting annual growth rates much beyond a 10-year planning horizon. Using the "Realistic" (higher) forecast, this results in a spectrum requirement of approximately 86 MHz in each direction, for GSO MSS.

(g) Total MSS Spectrum Forecast: Conventional MSS (GSO) + Handheld (NGSO)

Because of the uncertainty of long range forecasts, the total spectrum requirements for MSS should be estimated only out to the year 2005, as suggested in the most recent report of ITU-R Task Group 8/3. Taking the Inmarsat inputs to TG 8/3 as the basis for conventional MSS, while using market studies referred to above for handheld PC-MSS (provided by Non-GSO systems), the total "minimum (lower bound)" and "likely (realistic)" spectrum requirements will range from around 150 MHz (2 x 75) to 300 MHz (2 x 150) by the 2005. (see Figs 1-3 for growth curves)

References:

Satellite Personal Communications and their Consequences for European Telecommunications, Trade and Industry, KPMG Peat Marwick Report to the European Commission, March, 1994.

Wireless Electronic Mail and Facsimile Markets Worldwide, International Resource Development, Inc., November, 1993.

The Market for Mobile Satellite Services: Prospects for LEOs and GEOs, Leslie Taylor Associates, June, 1994.

Developments on the Mobile Data Communications Market, Arthur D. Little Inc., June, 1992.

Portable Computers & Wireless Communications, DataComm Research, Third Quarter, 1993.

INMARSAT in the 21st Century, Mary Ann Elliott and Betsy Kulick, 1994.

PCS Technologies Forecast, Personal Communications Industry Association, 1994.

3.2.2.2 Method for Converting MSS Voice Traffic Demand Forecasts into Spectrum Requirements (MSS Networks Above 1 GHz)

(a) Introduction

The Conference Preparatory Meeting (CPM) requested that TG 8/3 develop estimates of projected MSS service-link spectrum requirements. TG 8/3 received contributions from Administrations on MSS traffic forecasts.the future estimated demand for MSS. This document lays out a simplified methodology for converting MSS traffic forecasts into equivalent spectrum requirements.

(b) Conversion Method: Classical CCITT Method

Within the CCITT, Recommendation E.506, Forecasting International Traffic, includes an Annex (A) with a classic, composite-ratio method for converting the annual or monthly total paid-minutes of international traffic into the estimated mean carried busy-hour traffic (in Erlangs) using the formula:

$$A = (M*D*H) / (60*E) \qquad (1)$$

where:

A = the estimated mean traffic in Erlangs (busy-hour)

M = total monthly paid-minutes

D = busy day/month ratio

H = busy-hour/day ratio

E = efficiency factor; i.e., the ratio of busy-hour paid-time to busy-hour occupied time. Forecasts of efficiency can be made from extrapolation of past trends, generally in the range of .8 to .9, depending on signalling system characteristics.

3.2.2.3 Steps to applying CCITT Classical Method

For new types of systems or services, data may not be available for total monthly paid-minutes. In this case, the value M may be taken as the product of the estimated number of subscribers, $N_{subscribers}$, and the estimated average number of minutes of use per month for an average subscriber, MOU. For this purpose, values of D, H, E can be estimated from a comparable existing service.

From this point, two additional steps are needed to determine the RF spectrum requirements. First, Erlang peak busy-hour traffic must be converted into the equivalent number of voice channels, with the required percentage of blocking, or grade of service, via the standard Erlang-B Tables or graphs; using a known design for the grouping of traffic streams or trunks, which would generally construed to be individual transponder beams in the case of satellites. Second, the voice channel loading must then be converted into RF bandwidth, using standard transmission parameters; e.g., equivalent bandwidth/channel.

(c) Simplified Method to Determine the MSS Spectrum Requirements

The starting point for this method is a simplified version of the classical CCITT conversion formula and the subsequent two-step method outlined above.

This section describes the overall logic used to convert the MSS traffic demand into the required radio frequency (RF) spectrum. The formulas presented below are directly applicable only to FDMA systems. These equations can be adapted for TDMA and/or CDMA by the addition of other factors; such as, in the case of CDMA, the pseudo-random noise chipping rate and the self-jamming noise contribution. The equations are based on input documents to ITU-R Task Group 8/3 made by the U.S. and Inmarsat.

The first block of data taken from the MSS market studies is used to derive the total global traffic load in terms of "Erlangs offered during the peak hour" denoted as Aww in the following formula:

$$Aww = (N_{subscribers} * MOU) \ / \ (60*M*D*H*E \ ) \ldots\ldots\ldots\ldots (1')$$

Note that H, the ratio of peak hour traffic to daily traffic, is typically on the order of 10%.

Next, parameters are used to convert the worldwide Erlang loading into the number of voice channels needed to carry that level of traffic. The Erlang-B equation tables are used to provide the relationship between traffic level offered, grade of service (blocking probability) and number of channels in the trunk group. To simplify the calculation, we assume the number of channels is equal to the number of Erlangs of traffic (1 channel per Erlang), which is justifiable for satellites carrying 100 or more channels per spot beam (consider a spot beam as a trunk group):

$$Nc = Aww * Ferlang \ldots\ldots\ldots\ldots (2)$$

The third block of parameters are used to calculate the RF bandwidth needed to transmit each voice channel for digital transmissions by the following equation:

$$Bc = Rvocoder * ((1 + Foverhead) / Rfec) * Fm\text{-}ary * (1 + Fguard) * (1 + Fsig) \ldots (3).$$

where:

Bc =	Bandwidth per channel
Rv'r =	Output bit rate of vocoder
Fo'd =	Channel overhead factor as the ratio of framing and in-channel signalling bits to vocoder bits
Rfec =	Forward error correction rate
Fm-ary =	Conversion factor from bits to Hz
Fgaurd =	Guard band factor as a fraction of the occupied bandwidth of the channel
Fsig =	Ratio of signalling channels to working (traffic bearing) channels

The total worldwide bandwidth (in MHz) required per beam is given by the formula:

$$Bww = Nc * Bc * 10\text{-}6$$

Bww, Total bandwidth requirement . . . . (4)

Finally, the total RF spectrum for voice services required to satisfy the overall demand, denoted by $Sreq\_^{v}$ is calculated from the following formula:

$$Sreq\_^{v} = Bww * (1/Ffp) * (1/Nb) * Fhotspot * Nreuse \quad \text{.................} \quad (5)$$

$Sreq\_^{v}$ = Total spectrum requirement for voice traffic
Ffp = Frequency planning efficiency factor
Nb = Number of satellite beams covering the world's area that generates the traffic
Fh't = Hot spot factor
Nreuse = Number of beams in frequency repetition factor

Equation (5) is an approximation which takes into account the geometric factors relating to the way spectrum is assigned to individual spot beams and the practical levels of frequency reuse attainable within a given NGSO satellite. This, in turn, depends on factors such as the area of visibility of the earth, as viewed by the satellite (at a given orbital altitude), the number of spot beams per satellite, and the number of beams which cannot re-use frequencies because of their overlap with adjacent beams on the same satellite or other satellites which illuminate the same geographic areas of the earth. Unfortunately, these factors are highly configuration dependent on the system parameters of the different NGSO constellations. This formula uses an empirically derived "hot-spot factor" to take account of non-uniform distribution of traffic over the world's land area as a function of the different satellite altitudes and varying number of spot beams which are used and the consequential effective frequency reuse attained on these systems. Table I provides a range of values for the "hot-spot factor" for GSO/ICO/LEO type MSS systems. A conceptual discussion of satellite spot-beam frequency reuse, geographic distribution of traffic and several other pertinent factors is provided below.

(d) Discussion and Conclusion

The general methodology is outlined in this section, in the stated analytical formulas, may be used to convert a traffic forecast for a particular MSS service into a peak Erlang requirement. Thus, a given level of forecast "traffic intensity" or Erlangs is converted into the equivalent number of voice channels (overall worldwide requirement for MSS), using a certain grade of service with the use of the Erlang conversion formula. The conversion formula takes into account the composite peak to average ratio. In the estimation process, a given ratio can be substituted into the formula based on experience from existing MSS or cellular operators. Subsequently, the calculated voice channel loading can be converted into a bandwidth requirement using the appropriate transmission parameters; e.g., modulation type, encoder bit rate/voice channel, forward error control (FEC) rate, channel spacing, including guard bands with practical filtering.

3.2.2.4 Other Factors

In order to accurately estimate the overall MSS service-link spectrum requirements, several other factors must be taken into account. Most important of these is the level of frequency reuse attainable by a given MSS system. The frequency reuse factor, in turn, will depend on: (1) satellite spot-beam reuse factor; (2) mobile earth stations (MES) isolation; and (3) the geographic distribution of traffic.

(a) Satellite Spot-Beam Reuse

All the MSS systems being proposed to date (GSO or NGSO) make use of a number of spot beams which are sufficiently isolated from each other (in geographically separated coverage areas) to allow the same group of carrier frequencies to be re-assigned F reuse times among a pattern of different spot beams (usually non-adjacent beams). This allows reuse of the spectrum, so that the total bandwidth requirement can be divided down by F reuse -to yield the net overall spectrum requirement. An average level of global frequency reuse must be assumed in this model. This, in turn, will depend on the geographic distribution of traffic. (see 4.3)

(b) Mobile Earth Station (MES) Isolation, if any

In existing maritime/aeronautical and some land mobile earth stations, medium to high-gain, directive antennas are used. This provides a level of off-axis discrimination in the direction of the unwanted satellite network. Particularly for wide-spaced GSO/MSS networks, this MES antenna isolation may allow co-channel or staggered-channel frequency reuse, even without reliance on any spot beam isolation. However, for handheld MSS services, MES portability and small size are of paramount importance, so these MSS services will typically employ near omni-directional antennas. This means that it is extremely unlikely that frequency reuse by virtue of MES off-axis isolation will be attainable in overlapping coverage areas between adjacent satellites in GSO or NGSO satellites serving common or overlapping coverage areas. To be conservative, no advantage in MES isolation should be assumed in applying this model.

(c) Geographic Distribution of Traffic

The net level of frequency reuse that can actually be achieved by an MSS system is also dependent on the geographic distribution of traffic over the spot beam coverages of the satellite. For initial purposes of this model, one could assume a uniform distribution of traffic over the world (or land-mass areas of the world). However, in reality, market studies done to date indicate that the major demand for MSS personal communications is really concentrated in the Western Hemisphere, certain developing countries and in the Asia Pacific region. This concentration of traffic in certain countries or geographic regions will have the effect of limiting the actual level of frequency reuse that can be attained, regardless of the theoretical level that would be possible with the spot beam reuse patterns and an assumed uniform traffic distribution. This is because the channels/beam will be very low in spot beams covering certain regions and never approach the maximum capacity the system is capable of providing in those beams; whereas, the traffic loading will actually hit or exceed the maximums in particular spot beams over the peak traffic areas.

WRC-95 agenda item 2.1(a) calls for the review of the technical constraints associated with the frequency bands allocated below 3 GHz to MSS and associated provisions, resolutions and recommendations with a view towards facilitating the use of these bands by MSS with due regard to existing services.

As a result of WARC-92, up to 399 MHz of spectrum between 1 and 3 GHz is currently allocated to MSS, although the bandwidth and status (primary or secondary) of some of the MSS allocations vary among the three Regions. Only 201 MHz is allocated on a worldwide co-primary basis to MSS. Moreover, the usability of these bands by new or expanded MSS systems is limited by existing usage and by various regulatory provisions described below.

3.3 Existing MSS Allocations

3.3.1 Usability of Bands

This section of the report provides a preliminary review of the current MSS allocations between 1 and 3 GHz. Similar reviews are being conducted in other areas, such as ITU-R TG-8/3 in preparation for the CPM, and the results of those studies have not yet been incorporated into this report.

(a) Possible Use Of The Bands Allocated

Table 3.3.1-a lists the bands between 1 and 3 GHz that are currently allocated to MSS, including a brief summary of the allocation status, sharing conditions and MSS usage. More specific details concerning these bands are provided in the following paragraphs.

1492-1525/ MHz. WARC-92 allocated this band on a primary basis to MSS only in Region 2. The 1492-1525 MHz band is not currently available for MSS use in the United States (see RR No. 722B) because of potential interference to existing aeronautical telemetry operations. The sharing conditions in this band are addressed in Section 3.3.2(d) below.

1675-1710 MHz. WARC-92 allocated this band on a primary basis to MSS only in Region 2. This band is currently used for meteorological aids and meteorological satellites on a worldwide basis. The feasibility of implementing MSS systems in this band is addressed in Sections 3.3.2(a)3 and 3.3.2(g) below.

1525-1559/1626.5-1660.5 MHz. These bands have been allocated for MSS since the 1971 WARC, although adjustments to the MSS allocations were made by subsequent conferences in 1979, 1987 and 1992. MSS systems, such as Marisat and Inmarsat, have been operational in the lower portion of these bands since the mid-1970s, and the American Mobile Satellite Corporation has been licensed to operate a domestic MSS system in the upper portion of these bands. The allocation structure of these bands is complex, with different portions allocated to the mobile-satellite service, the maritime mobile-satellite service, the aeronautical (R) mobile-satellite service, and the land mobile satellite service. There are a large number of other geostationary MSS systems planned or operating in these bands, and the ongoing coordination of all of these MSS systems is proving to be very difficult.

1610-1626.5/2483.5-2500 MHz. These bands were initially allocated to the radiodetermination-satellite service by the 1987 WARC. Worldwide primary MSS allocations were adopted by WARC-92, primarily to accommodate the then newly proposed non-GSO MSS systems. The sharing conditions in these bands are complex as reflected by the numerous footnotes to these bands in the Table of Allocations. A detailed examination of all of these sharing conditions was conducted during the proceedings in CC Docket No. 92-166 and the results are reflected in the recent amendments to Part 25 of the FCC's Rules and Regulations adopted by the Report and Order (FCC 92-261) released October 14, 1994 in that proceeding. The FCC is expected to issue licenses for several non-GSO MSS systems in these bands in early 1995.

1930-1980/2120-2170 MHz. WARC-92 allocated these bands only in Region 2. However, only 10 MHz of each band is allocated on a primary basis to MSS, the other 40 MHz being allocated to MSS on a secondary basis. These bands are heavily used by terrestrial services and the utility of these bands for MSS will depend on the results of the sharing studies being conducted with respect to the fixed and mobile services currently operating in these bands. Moreover, recent FCC decisions concerning the auctioning of spectrum for PCS in the United States has substantially reduced the likelihood of that United States MSS systems could be operated as a practical matter in the 1970-1980 MHz portion of these band.

1980-2010/2170-2200 MHz. These WARC-92 MSS allocations fall within the bands identified in RR No. 746A for worldwide implementation of FPLMTS, and these bands are often assumed to be the bands in which the satellite component of future PCS systems would eventually be implemented. These bands are heavily used by terrestrial services and the utility of these bands for MSS will depend on the results of the sharing studies being conducted with respect to the fixed and mobile services currently operating in these bands. Moreover, recent FCC decisions concerning the auctioning of spectrum for PCS in the United States has substantially reduced the likelihood of that United States MSS systems could be operated as a practical matter in the 1980-1990 MHz portion of these bands.

2500-2535/2655-2690 MHz. The 2500-2535 MHz (space-to-earth) and 2655-2690 MHz (earth-to-space) bands are used in the United States primarily for Instructional Fixed Television Service (ITFS) and Multichannel Multipoint Distribution Service (MMDS). At WARC-92, the bands were allocated for MSS use as well.

ALLOCATED BAND (MHZ)	MSS ALLOCATION STATUS	SHARING CONDITIONS SUMMARY	MSS USAGE
1492-1525 (downlink)	33 MHz Region 2 (primary)	Fixed Mobile	Not available in U.S. due to aeronautical telemetry in downlink band;
1675-1710 (uplink)	35 MHz Region 2 (primary)	MetAids, Metsat, fixed and mobile	MetAids and Metsat currently in operation in uplink band: no current MSS systems
1525-1559 (downlink) 1626.5-1660.5 (uplink)	34 MHz Worldwide (primary)	Sharing with fixed in certain countries under RR 730; some sub-bands subject to sharing.	Heavy usage by current and planned GSO MSS systems
1610-1626.5 (uplink) 1613.8-1626.5 (downlink) 2483.5-2500 (downlink)	16.5 MHz Worldwide (primary uplink) 11.7 MHz Worldwide (secondary downlink) 16.5 MHz Worldwide (primary)	Aeronautical radionavigation (including satellites), radioastronomy, and fixed in certain countries under RR 730 in uplink. Fixed, mobile, ISM, radiolocation in downlink.	Multiple non-GSO MSS/RDSS systems planned for these bands.
1930-1980 (uplink) 2120-2170 (downlink)	50 MHz Region 2 (40 MHz secondary) (10 MHz primary)	Fixed Mobile	No current MSS usage
1980-2010 (uplink) 2170-2200 (downlink)	30 MHz Worldwide (primary)	Fixed Mobile	No current MSS usage
2500-2535 (downlink) 2655-2690 (uplink)	20 MHz Worldwide (primary) 15 MHz Worldwide (primary footnotes for national systems)	Fixed Mobile BSS FSS	No U.S. plans due to heavy MMDS usage

Table 3.3.1-a. MSS Band Summary

The U.S. wanted this allocation limited to Region 1 and Region 3 to prevent interference with ITFS and MMDS in the United States. Although this allocation was not limited by regions, a footnote was added to the allocation table limiting the use of these bands to national boundaries. Moreover, the coordination procedures of Resolution No. 42 (WARC-92) ensure that interference to U.S. operations in the subject bands from planned MSS systems can be prevented. At WRC-95, the U.S. needs to ensure that the footnote limitation of MSS to national boundaries and suitable coordination provisions be retained in order to protect U.S. ITFS and MMDS operations.

(b) Need For Improvement Of Band Use

Section 3.3.3 below addresses the desirability of generic MSS allocations throughout the 1525-1559 MHz and 1626.5-1660.5 MHz MSS bands, and section 3.4 below addresses the dates on which MSS use can be made of certain of these bands. Changes to certain footnote provisions of some of these MSS allocations are also desirable and are discussed in this section of the report.

(i) 1610-1626.5 MHz

Although the international Table of Frequency Allocations provides a primary status to the mobile-satellite service (Earth-to-space) (MSS) in all three Regions in the 1610-1626.5 MHz band, footnotes RR Nos. 731E and 733E contain language that appears to be in contradiction to the primary status of MSS.

Specifically, RR No. 733E states that:

> Harmful interference shall not be caused to stations of the radio astronomy service using the band 1610.6-1613.8 MHz by stations of the radiodetermination-satellite and mobile-satellite service. (No. 2904 applies.)

while the last sentence of RR No. 731E states that:

> . . . Stations of the mobile-satellite service shall not cause harmful interference to, nor claim protection from, stations in the aeronautical radionavigation service, stations operating in accordance with the provisions of No. 732 and stations in the fixed service operating in accordance with the provisions of No. 730.

This footnote text is essentially the same as the text used in the definition of a secondary service in RR Nos. 420-423. This text is unnecessary and redundant to protect the primary status of the other services in the bands. Moreover, the apparent contradiction between this footnote text and primary table status is likely to cause confusion and difficulties in the application of the Resolution 46 coordination procedures for U.S. MSS systems in this band, and is in violation of principles recommended by the Voluntary Group of Experts to clarify and simply the footnotes to the Table of Allocations.

RR No. 733E was originally adopted by the 1987 WARC as a Region 1 and 3 footnote at a time when radio astronomy had only secondary status worldwide and the radiodetermination-satellite service (RDSS) was being introduced on a secondary basis in these Regions except for the primary status afforded RDSS in the Region 1 and 3 countries listed in RR No. 733B.

The radio astronomy community feels that the provisions of RR 733E should be retained. The band 1610.6-1613.8 MHz, allocated to the Radio Astronomy Service (RAS) on a Primary basis, is a sub-band of the larger band, 1610-1626.5 MHz, which is allocated to the MSS on a Primary basis. MSS providers expect to utilize the entire 1610-1626.5 MHz band for Earth-to-space transmissions from mobile units using CDMA modulation. Such transmissions may cause harmful interference to the RAS, and in fact render the band useless for radio astronomy in the absence of special coordination measures. RR 733E is a reminder of the need for such coordination measures. For years this special need has been clearly recognized by several international Radio Conferences including WARC-87 and WARC-92, by the VGE of the ITU, which retained RR 733E while deleting other, redundant footnotes relative to the RAS, and most recently by the FCC which, in paragraph 113 of its R&O, adopted the recommendation of the MSS Negotiated Rulemaking Committee by incorporating in its domestic rules the protection of RAS provided by RR 733E.

With the elevation of radio astronomy to primary status in all three Regions at the 1992 WARC, any special recognition intended by the 1987 WARC is no longer needed, especially in light of RR No. 734. In addition, the FCC's recent Report and Order in CC Docket 92-166 adopted rules that provide all the protection needed by radioastronomy in this band. Moreover, although the view has been expressed that the intent of this footnote is to provide protection to radioastronomy from out-of-band emissions caused by MSS transmitters operating anywhere within the 1610-1626.5 MHz band, the provisions of RR No. 344 continue to apply.

Similarly, the contradictory last sentence in RR No. 731E is unnecessary to provide any special recognition of radionavigation services that may have been intended at the 1992 WARC since RR No. 953 continues to apply, particularly in light of ongoing coordination and the recent Memorandum of Understanding between the FCC, NTIA and FAA to resolve these issues. See FCC News, Mimeo 50736, released November 18, 1994.

In addition, footnote 731E states that the e.i.r.p. density of an MSS or RDSS mobile earth station transmitting in the band 1610-1626.5 MHz shall not be in excess of -15dBW/4kHz or - 3dBW/4kHz, depending on whether the emission is in a portion of the band employed by a system operating in accordance with the provisions of RR 732 (e.g. Glonass). There is no indication in the Radio Regulations nor the "legislative" history of this footnote whether these limits should be based on peak or average e.i.r.p. densities.

The FCC, in the Rules accompanying its Big LEO Report and Order, did not clarify this situation. However, in regard to out-of-band e.i.r.p. density from the same stations, the new FCC limit is based on an average over a 20 msec period.

Based in part on U.S. support, the November/December 1994 meeting of ITU-R Task Group 8/3 included the following paragraph in its report to the CPM for WRC-95:

> There is a need to clarify how the e.i.r.p. density limits given in RR 731E should be measured. In assessing whether the limit of RR 731E is exceeded, Task Group 8/3 is of the opinion that these limits should be understood to be the mean e.i.r.p. in a reference bandwidth of 4 kHz, given in dB(W/4kHz).

(ii) <u>2483.5-2500 MHz</u>

RR No. 753F adopted at WARC-92 requires coordination of an MSS system in the 2483.5-2500 MHz band with terrestrial services under the provisions of Resolution 46 if the power flux density (PFD) exceeds the levels specified in RR No. 2566, which states that:

> The power flux-density at the Earth's surface produced by emissions from a space station, including emissions from a reflecting satellite, for all conditions and for all methods of modulation, shall not exceed the following values:
>
> > -152 dB(W/m^2) in any 4 kHz band for angles of arrival between 0 and 5 degrees above the horizontal plane;
> >
> > -152 + 0.5(d-5) dB(W/m^2) in any 4 kHz band for angles of arrival d (in degrees) between 5 and 25 degrees above the horizontal plane;
> >
> > -142 dB(W/m^2) in any 4 kHz band for angles of arrival between 25 and 90 degrees above the horizontal plane.
>
> These limits relate to the power flux-density which would be obtained under assumed free-space conditions.

For non-geostationary MSS systems, exceeding this PFD level may result in coordination being required with every one of the 160 or more members of the ITU, which would add substantial cost and delay to the implementation of non-GSO MSS systems in this band. However, strict compliance with the RR No. 2566 PFD limits results in significant capacity limitations and inter-system coordination constraints, particularly in areas served by MSS satellites with elevation angles between about 15 and 25 degrees where the satellite power is constrained by the RR No. 2566 levels and not the inter-system coordination constraints.

Since WARC-92, substantial analysis has been undertaken which demonstrates that these PFD limits are unduly stringent with regard to non-geostationary MSS systems. Thus, these limits should be increased to facilitate the introduction of non-geostationary MSS systems. Relaxation of these values will not only accommodate non-geostationary MSS systems, but will also continue to meet protection requirements for analog point-to-point and multipoint fixed systems as recommended by the ITU-R. Moreover, an increase in the values will enable MSS systems to proceed without triggering unnecessary and time consuming coordination which would also impact the fixed service providers.

Recent analysis of the impact of the proposed operation of non-geostationary MSS systems on fixed services operating in the 2483.5-2500 MHz band demonstrates that typical CDMA non-GSO MSS operations at the higher PFD proposed will meet the protection requirements recommended by the ITU-R to safeguard the operation of analog point-to-point and multipoint fixed systems. See, e.g., 8 December Draft New Recommendation, Document 2-2/TEMP/89 (Rev1), 13 September 1994. These analyses demonstrate that operation of CDMA non-GSO MSS systems with characteristics similar to those proposed by the U.S. non-GSO MSS applicants within these PFD limits would not cause harmful interference into analog line-of-sight radio relay systems.

The report of Radiocommunication Sector TG 2-2 states that:

> there appears to be some sharing margin available between certain MSS and fixed service systems which have not been fully exploited. First, Non-GSO MSS satellite systems have more system design variables than GSO MSS systems. For example, Doc. 2-2/26 indicates the influence of spot beam use on non-GSO MSS satellites in improving the possibility of sharing. Also, Doc. 2-2/31 show how system pfd levels can be improved by taking account of the orbital transmission characteristics of a particular system. Doc. 2-2/27 indicates how the pfd level can be improved as a consequence of the statistical properties of the system implemented.

The technical studies performed to date include simulations of interference into various types of analog and digital point-to-point and multipoint fixed systems, and analyses of the potential impact on these systems. The results show that interference to almost all 2,500 km analog radio relay routes will be within values contained in Recommendation ITU-R F.357 for the higher proposed PFD levels. However, digital radio relay systems may be significantly impacted at these higher PFD levels. However, within the United States, there are few grandfathered fixed service systems operating in the 2483.5-2500 MHz, and the majority of fixed systems in this band are analog. For the affected digital systems, they may employ various techniques, such as increased power, to mitigate any interference effects. Thus, few fixed service systems would be impacted by increasing the PFD level in the band. Moreover, this proposal affects only a small band segment available to the fixed service in this portion of the spectrum, and sensitive digital fixed systems requiring greater interference protection can be located in portions of the band not allocated to MSS.

3.3.2 Feasibility of MSS Sharing

3.3.2.1 MSS Sharing with Space Services

a. Sharing among MSS networks

MSS networks employing narrow band channels with frequency division multiple access (FDMA) or time division multiple access (TDMA) techniques cannot share frequencies on a co-coverage basis (band segmentation is used to achieve sharing). Co-frequency, co-coverage sharing may be possible between MSS networks using FDMA or TDMA and networks using a limited number of code division multiple access (CDMA) channels. MSS networks employing CDMA can share on a co-frequency, co-coverage basis with capacity constraints that increase with the number of such co-frequency networks.

b. Sharing with the space operation service

The space operation (space-to-Earth) service shares the 1525-1535 MHz band with MSS (space-to-Earth). Protection criteria for, and information on spectrum usage by, space operation systems are given in Recommendation ITU-R SA.363-5, which notes that integration of space operation functions with data transmission or communication links (i.e., in other bands) has a number of advantages, including spectrum utilization efficiency, and that this is the normal practice. The Recommendation also notes that the necessary bandwidth of space operation links typically range between 200 kHz and 1 MHz. Thus, the space operation service poses only modest sharing constraints, particularly in the case of systems making temporary or exceptional use of MSS allocations.

c. Sharing with the meteorological-satellite (space-to-Earth) service

The meteorological-satellite (space-to-Earth) service shares the 1675-1710 MHz band with MSS (Earth-to-space) in Region 2. ITU-R Working Party 7C has completed a draft new Recommendation regarding the sharing between meteorological-satellite service (space-to-Earth) and MSS (Earth-to-space) in the 1675-1710 MHz band (Doc. 7C/TEMP/4(Rev.2)). The general conclusion of the Recommendation is that sharing is possible under certain conditions noting the following:

· that additional studies are required to further clarify the specific sharing conditions between earth stations and between space stations in the meteorological-satellite service and MSS;

· that a separation distance of approximately 40 km may be required to prevent co-channel interference to a meteorological-satellite earth station from a mobile earth station (this separation distance is considerably reduced when mobile earth stations transmit on channels adjacent to those used by meteorological-satellite earth stations);

· that for more than 20 years the international group of meteorological satellite operators (CGMS) has agreed to use the 1675 - 1710 MHz band in the following manner:

1675-1690 MHz - main earth stations at fixed locations for reception of raw image data, data collection transmissions and spacecraft telemetry from geostationary meteorological satellites.

1690-1698 MHz - user stations for direct data readout services from geostationary meteorological satellites.

1698-1710 MHz - user stations for direct data readout and pre-recorded image data at main earth stations from non-geostationary meteorological satellites.

d. Sharing with the fixed-satellite service

After 1 January 2005, the fixed-satellite (space-to-Earth) service will be co-primary in the 2500-2520 MHz band with MSS (space-to-Earth). Also after 1 January 2005, the fixed-satellite (Earth-to-space) service will be co-primary in the 2670-2690 MHz band with MSS (Earth-to-space). Until 1 January 2005, MSS use of these bands and the adjacent 2520 - 2535 MHz and 2655-2670 MHz bands is subject to agreement obtained under RR Article 14. In establishing these co-primary allocations, WARC-92 recognized that sharing is feasible.

3.3.2.2 MSS sharing with the radio astronomy service

The 1610.6-1613.8 MHz and 1660.0-1660.5 MHz bands are shared between radio astronomy and MSS (Earth-to-space). Several applicable ITU-R Recommendations have been adopted for the protection of radio astronomy, including RA.1031 for identifying situations where frequency assignments for mobile earth stations should be coordinated with those of a radio astronomy receiver. Several techniques are under development for the achievement of efficient sharing on the basis of time, frequency and geographic separation. Although the separation distances required for co-channel sharing can exceed 100 km, depending on the e.i.r.p. of mobile earth stations, radio astronomy observatories are deployed with low geographic density and they do not operate at all times. Thus, this sharing situation poses local constraints on mobile earth station operations in some areas.

3.3.2.3 Sharing with the fixed service

Most of the bands allocated to the MSS in the 1-3 GHz range are also allocated to the fixed service. The greatest sharing constraints are associated with potential interference to satellite receivers in MSS (Earth-to-space) allocations and to fixed service receivers in MSS (space-to-Earth) allocations. Because large geographic areas are visible to a satellite, high aggregate levels of interfering signal power can be received by a satellite as a result of the potentially large numbers of interfering fixed stations and there is a significant probability that antenna main beams of one or more fixed systems will be directed temporarily at non-GSO satellites or permanently at GSO satellites (unless orbit avoidance is used). These sharing problems incur the greatest design and operating constraints because, among other things, interference could be caused or experienced by fixed stations located far outside the service area of an MSS network. In contrast, sharing between mobile earth stations and fixed stations is considered to be a local problem that can be addressed using the concept of coordination area (e.g., in accordance with ITU-R Recommendations IS.847, IS.848, IS.849 and IS.850).

a. Non-GSO MSS sharing with the fixed service

Sharing studies in ITU-R Task Group 2/2 focussed on the bands 1970 - 2010/2160 -2200 MHz and 1610 - 1626.5/2483.5 - 2500 MHz, since these are of immediate interest for implementation of MSS networks. Based on these studies it was concluded that in the Earth-to-space direction sharing is generally not feasible given current arrangements, and some regulatory options are suggested to facilitate the introduction of MSS. With regard to sharing in the space-to-Earth direction it was concluded that such sharing should be feasible, if necessary by undertaking bilateral coordinations. A draft new Recommendation (Doc. 2-2/TEMP/89 (Rev.1)) was developed to provide power flux density (pfd) and fractional degradation in performance (fdp) thresholds that are used to establish the need for coordination.

It is evident from the above conclusions that with respect to sharing, the usage of spectrum by MSS would affect the fixed service usage differently in the Earth-to-space and space -to-Earth directions. The actual impact of the introduction of MSS services in these bands concerned will largely depend on the extent of usage by the fixed service, and the changes made to channelization plans used by administrations.

In view of the differences in impact, different measures need to be taken by the fixed service and MSS in the early stages of MSS introduction so as to minimize the burden of transition of the fixed service, while at the same time permitting gradual introduction of the MSS. For example, in the short-term, in the Earth-to-space direction, the transition of the affected fixed service systems to other bands would be required in an earlier time-frame than for the fixed service systems affected in the space-to-Earth direction. However, in the long-term, as MSS traffic and spectrum requirements build up, sharing in both directions will become increasingly complex and difficult and eventual transitional arrangements for the fixed service to other bands are likely to be required.

b. GSO MSS sharing with the fixed service

Coordination guidelines for sharing frequencies between MSS (space-to-Earth) and the fixed service were addressed in a draft new Recommendation developed by ITU-R Task Group 2/2 (Doc. 2-2/TEMP/92 (Rev.1). This Recommendation provides pfd coordination thresholds that are consistent with RR 2566 for all the downlink bands allocated by WARC-92, with the exception of the 2520 - 2535 MHz band where a more stringent threshold value was adopted. Fixed system considerations that may facilitate successful coordination are addressed in an annex. The Recommendation states that co-channel sharing between MSS (Earth-to-space) and the fixed service is unworkable, and Task Group 2/2 was of the view that provisions should be made for avoiding co-channel sharing.

3.3.2.4 Sharing with the mobile (aeronautical telemetry) service

The band 1492-1525 MHz is allocated to the MSS (space-to-Earth) service in Region 2. The band is also allocated to the aeronautical mobile (telemetry) service in Region 2. In particular, the U.S. makes extensive use of this band for the testing of aircraft and associated avionics. Studies have shown that the power flux-density (pfd) generated in the same area as telemetry receiving stations must be limited to low levels in order to protect the telemetry receivers. The disparity between acceptable pfd levels and the pfd levels generated by MSS satellite downlinks has led to the conclusion that co-frequency, co-coverage sharing is not feasible. Because of the extensive frequency usage by telemetry systems, the spectrum available to MSS under non-co-frequency operation with co-coverage may be extremely limited unless both services take appropriate technical and operational measures to minimize the potential for interference. However, co-frequency, non-co-coverage operation is possible where sufficient separation can be achieved between the operational areas of the telemetry systems and the MSS coverage area. In this case, MSS coverage of portions of South America may be possible on a co-frequency basis.

3.3.2.5 Sharing with the mobile service (FPLMTS)

MSS (space-to-Earth) and (Earth-to-space) networks cannot share frequencies with the terrestrial component of FPLMTS in the same and adjacent geographic areas. However, sharing with MSS (space-to-Earth) may be feasible in a non-co-frequency, co-coverage environment.

3.3.2.6 Sharing with other mobile services

The criteria under development for sharing between the MSS (space-to-Earth) and receiving stations in the fixed service may also adequately protect mobile services, although further study is needed. Some systems in the mobile service (e.g., transportable equipment used for electronic news gathering) appear to be similar to certain types of fixed systems (e.g., point-to-multipoint systems). It is noted that in RR Article 28 (pfd limits on transmitting space stations) and Appendix 28 (parameters for calculation of coordination area), no distinction is made between systems in the terrestrial services (e.g., fixed and mobile). Thus, for the time being, it is reasonable to assume that sharing between general mobile services and the MSS is no more constraining than sharing between MSS and the fixed service.

3.3.2.7 Sharing with the meteorological aids service

The band 1675 - 1700 MHz is shared on a co-primary basis between MSS (Earth-to-space) and the meteorological aids service. Further study of the feasibility of sharing is required.

3.3.2.8 Sharing with the aeronautical radionavigation service

The 1610-1626.5 MHz band is shared between the aeronautical radionavigation service and MSS (Earth-to-space) on a co-primary basis. An analysis of sharing with respect to the high-power radars operated in the aeronautical radionavigation service by one administration indicates that no interference will be caused by transmitting mobile earth stations operating outside the territory of that administration. The analysis also indicates that under conditions of mutual visibility, the radars will generate high levels of interfering signal power at MSS satellite receiver; however, cooperative discussions among the parties involved and implementation of certain interference-mitigation techniques may eliminate the potential interference in the MSS networks, at least possibly for MSS service areas outside of the territory of the administration operating the aeronautical radionavigation system.

The potential for MSS interference to satellite-based aeronautical radionavigation systems operating at 1575.42 MHz (GPS) and 1602-1616 MHz (GLONASS) is under study. Recommendation ITU-R M.1088 gives information related to protection of GPS.

3.3.2.9 Sharing with the radiolocation service

The 2483.5-2500 MHz band is shared on a co-primary basis between MSS (space-to-Earth) and the radiolocation service. The radiolocation service is also allocated in the wider, adjacent bands spanning 2300 - 2483.5 MHz. One analysis indicates that MSS satellites operating at the pfd levels currently allowed under RR 2566 may interfere with radars in the radiolocation service. The possibility for radiolocation stations to avoid use of the 2483.5-2500 MHz band should be considered.

3.3.3 Generic Allocations

<u>1530-1544/1626.5-1645.5 MHz and 1545-1559/1646.5-1660.5 MHz</u>

The United States proposes to change the current allocations for the separate Aeronautical Mobile Satellite (Route) Service (AMS(R)S), Land Mobile Satellite Service (LMSS), and the Maritime Mobile Satellite Service (MMSS) into the Mobile Satellite Service (MSS).

A necessary and integral part of this proposal is the inclusion of footnotes that protect maritime mobile satellite distress and safety service in the lower L-band (1530-1544/1626.5-1645.5 MHz) and aeronautical safety service in the upper L-band (1545-1559/1646.5-1660.5 MHz). To provide this protection, the U.S. proposes that the allocation worldwide in the lower L-band worldwide be identical to that specified in footnote 726C (which currently applies only to certain countries including the U.S., Canada, and Mexico) and that the allocation worldwide in the upper L-band identical to that specified in footnote 730C (which also currently applies only to certain countries).

Additionally, the allocation at 1525-1530 MHz in the lower L-band should be made generic worldwide. The worldwide allocation at 1660-1660.5 MHz should be the same as in footnote 730C, which will continue to protect radio astronomy services. Finally, the priority and preemptive access requirement throughout the upper and lower L-bands is an intra-system requirement only.

Historically, there has been continued progress toward generic allocations domestically and internationally. The initial allocations were made in the 1970's to maritime and aeronautical services because discrete systems were being proposed for these users. With the evolution of Inmarsat from maritime service to aeronautical and land mobile services and the failure of attempts to establish a dedicated aeronautical system, the U.S. government took the lead in promoting a shift toward a generic allocation. U.S. proposals at the World Administrative Radiocommunications Conference (WARC-MOB-87) in 1987 were successful only in adding secondary LMSS allocations in the existing bands. As a result, the U.S. took reservations with respect to these allocations. Protocol No. 58 WARC-MOB-87.

U.S. efforts met with greater success at WARC-92. There, the conference adopted footnotes (726C and 730C) establishing additional allocations for Argentina, Australia, Brazil, Canada, Malaysia, Mexico and the U.S. specifying a primary allocation to generic MSS, with appropriate safeguards for maritime safety and distress communications in the lower L-band and for aeronautical safety communications in the top 4 MHz of the upper L-band. Unfortunately, 10 MHz (1545-1555/1646.5-1656.5 MHz) of the upper L-band was not made generic, by footnote or otherwise. WRC-93, which was largely an agenda-setting conference, agreed to include for consideration at WRC-95 the improvement of the existing MSS allocations, an item that includes proposals to make the allocations generic.

The FCC in recent years has consistently supported generic MSS allocations with appropriate safeguards for the priority of aeronautical and maritime safety communications. See Memorandum Opinion and Order in Gen. Docket No. 84-1234 (1989) (allocating the upper L-band to be shared by generic MSS and aeronautical MSS); see also First Report and Order and Further NPRM in Gen. Docket No. 90-56, 8 FCC Rcd 4246 (1993) (allocating the 1530-1544/1626.5-1645.5 MHz band to generic MSS and proposing to allocate the 1525-1530 MHz band to generic MSS). WRC-95 provides an opportunity for the U.S. to promote, once again, the efficiencies of generic allocations.

3.4 Date of Entry Into Force

3.4.1 Introduction

Agenda item 2.1.b) of WRC-95 is to review the date of entry into force of MSS allocations in the bands 1980-2010 MHz and 2170-2200 MHz in Regions 1 and 3 and the bands 1970-2010 MHz and 2160-2200 MHz in Region 2 (the 2 GHz MSS allocations). These bands were allocated to the MSS at WARC-92. They are also allocated to the mobile and fixed services on an equal primary basis and are subject to the provisions of RR 746B and 746C. RR 746B states that the use of these bands "...shall not commence before 1 January 2005..." An exception to this date of entry into force exists in RR 746C which states "In the United States of America, the use of the bands ...shall not commence before 1 January 1996."

3.4.2 MSS Requirements for Access to the 2 GHz Bands

Between WARC-92 and September 1994 more that 20 MSS systems,both GSO and NGSO, have been Advanced Published in the 2 GHz bands. Some of these NGSO systems are intended to provide a worldwide service with implementation dates between 1994 and 2000. Two U.S. companies have applied to the FCC to construct GSO MSS systems in this band. These systems could be operational before the year 2000.

The other bands allocated to the MSS, 1610-1626.5/2483.5-2500 MHz, are likely to become saturated prior to the year 2005. As of September 1994, 43 GSO and NGSO systems have been published in the ITU records. The number of these systems, their technical and operational characteristics such as global coverage and omni-directional antenna patterns and the constraints imposed by sharing the spectrum with other services all serve to reduce the usable spectrum for MSS.

3.4.3 Impact of FPLMTS

RR 746A indicates that the bands 1885-2025 MHz and 2110-2200 MHz are intended for use, on a worldwide basis, by Administrations wishing to implement the future public land mobile telecommunication systems (FPLMTS). Although such use does not preclude the use of these bands by other services to which the bands are also allocated.

The ITU-R Recommendations which define the terrestrial and satellite components of FPLMTS are optimistically expected by the end of 1997. Typically, there is a five year period between the start of satellite construction and provision of service. Realistically, it is likely that a U.S. MSS FPLMTS system will not be operational prior to the year 2005. However, some MSS operators planning to provide services at 2 GHz around the year 2000 plan to maintain sufficient flexibility in their systems designs to implement and operate their systems in a manner consistent with FPLMTS Recommendations.

Changing the date of entry into force to an earlier date would mean less spectrum would be available to the satellite component of FPLMTS if part of the 2 GHz allocations were used for MSS not compatible with FPLMTS.

3.4.4 Sharing with the Fixed Service

Earth-to-space: ITU-R studies show that the aggregate interference from FS transmitters in densely used parts of the 1980-2010 MHz band within visibility of NGSO MSS satellites would be unacceptable. Because of this unacceptable level of interference ITU-R task Group 2/2 concluded that a phased transition plan could be used to facilitate the introduction of MSS in the band 1980-2010 MHz.

Space-to-Earth: ITU-R studies indicate that when detailed NGSO MSS and FS system characteristics are taken into account sharing between NGSO MSS and typical short haul analogue and digital FS systems could be feasible in the band 2170-2200 MHz, especially when MSS traffic levels are low. In the long term, when MSS traffic levels are high, sharing will be difficult unless appropriate technical modifications or transitions are made to fixed systems. If sharing constraints were relaxed, the capacity of the MSS systems could be improved.

One means to provide for the introduction of MSS in the 2 GHz bands around the year 2000 would be to use non-overlapping portions of the spectrum in the ITU-R channel plans for the fixed service in both the uplink and downlink bands. However it is unlikely that common non-overlapping spectrum could be found on a global basis.

3.4.5 Conclusion

Given the sharing difficulties that exist on a global basis, one possibility of introducing the MSS into the 2 GHz bands would be to develop a transition plan employing the concept of band segmentation. This would include the gradual introduction of the MSS with a corresponding displacement of the fixed service.

The U.S. should propose no change to RR 746C. At the same time the U.S. should adopt a position to support the development of a transition plan to gradually introduce MSS in the 2 GHz bands starting some time prior to the year 2005.

3.5 Additional MSS Allocations As Necessary (Agenda (d))

WRC-95 agenda item 3(d) calls for the consideration of the requirements for the MSS and if necessary adopt limited allocations in 1995.

3.5.1 Adequacy of Existing Allocations

IWG-3 has conservatively estimated that the total MSS spectrum requirements will range from 150 to 300 MHz by the year 2005. See section 3.2 above. It is clear from the previous sections that the existing allocations are insufficient to satisfy these requirements and that additional spectrum will have to be allocated by WRC-95 to the MSS.

The usability of the 68 MHz at 1525-1559/1626.5-1660.5 MHz can be enhanced by making the allocations generic MSS as discussed in Section 3.3.3 above. The 33 MHz at 1610-1626.5/2483.5-2500 MHz can be enhanced for non-GSO MSS with changes to certain of the footnotes as discussed in Section 3.3.1(b) above. However, these bands are barely sufficient for accommodating only the currently licensed GSO and soon to be licensed non-GSO MSS systems. Moreover, international coordination of U.S. systems in these bands will be difficult in light of the large number of systems proposed by other countries in these bands.

MSS growth will have to be accommodated in other bands between 1 and 3 GHz. However, all such bands are currently being used by other services. In particular, the committee does not consider the 33 MHz at 1492-1525 MHz, the 20 MHz at 1970-1990 MHz, or the 70 MHz in the 2500-2690 MHz band to be available for meeting United States MSS requirements. The usability of the 80 MHz of secondary Region 2 allocations at 1930-1970 and 2120-2160 MHz is also questionable. In addition, the 33 MHz at 1492-1525 MHz, the 35 MHz at 1675-1710 MHz and the 100 MHz at 1930-1980/2170-2200 MHz is not usable by non-GSO MSS systems since these allocations are limited to Region 2. Thus, a total of 238 MHz out of the total of 399 MHz of MSS allocated spectrum (i.e. approximately 60%) may not be usable as a practical matter to satisfy United States MSS spectrum requirements, leaving only 161 MHz available to satisfy the identified MSS spectrum requirements, both GSO and non-GSO.

For these reasons, the preliminary conclusion of the committee is that the United States should propose additional MSS allocations under this agenda item as discussed in the next subsection.

3.5.2 Potential Candidate Bands for New Allocations

Additional spectrum is needed to meet the demand for mobile services. To ensure that there are enough bands to meet demand, the United States needs to secure additional spectrum. Potential new MSS allocations include 1559-1569, 2010-2025, 2165-2170 and possibly others. Attaining more spectrum is critical for future Mobile Satellite Services in the United States and the WRC-95 provides an ideal opportunity for the U.S. to express interest in these bands and possibly attain new MSS allocations in these bands.

1559-1569 MHz (space-to-Earth)

The U.S. should propose adding an MSS allocation in the bands 1559-1569 MHz. The allocation should include a footnote (731 G) stating that, in the interim, and pending completion of studies, the power flux density generated at the earth's surface by geostationary space stations shall not exceed -134 dBW/m2 per 4 kHz. In addition, the footnote (731 G) should apply the provisions of RR 2585 in order to allow that power flux density level to exceed with the permission of administrations that may be affected. A limit on the power flux density generated by GSO MSS satellites is needed for protection of radio navigation services. Statistics are needed to determine appropriate sharing criteria for non-GSO MSS systems.

2010-2025 MHz and 2165-2170 MHz

Since WRC-93, the FCC allocated the 1970-1990 MHz band to terrestrial PCS, thereby precluding operation of MSS despite an international MSS allocation in the bands. Thus, additional MSS allocations are needed in the vicinity of the 2GHz bands.

A potential new MSS allocation at 2010-2025 MHz has been proposed in the FCC proceeding in preparation for WRC-95. The band is allocated internationally and domestically to the Fixed and Mobile Services. In the United States, the band is part of a larger (1990-2110 MHz) used primarily by broadcasters for auxiliary services in the U.S., including electronic news gathering. There is also a proposal to make the 2165-2170 MHz band a global allocation. Power limits on terrestrial systems will be required in order to ensure enough useable spectrum for MSS systems.

1675-1710 MHz (Earth-to-space) - this band is allocated for MSS use in Region 2 only

Sharing analyses demonstrate the feasibility of sharing with meteorological satellite. Further work is required to address sharing with METAIDs which are primarily used in the United States. Consideration should be given to expanding the allocation to all three regions.

2300-2310 (Earth-to-space/space-to-Earth)

This band is allocated to the fixed, mobile and radiolocation services and on a secondary basis to the amateur service. It has been identified for possible use in either the space-to-Earth or Earth-to-space directions. However appropriate sharing studies have not been completed.

2390-2400 MHz (Earth-to-space)

This band currently is allocated to fixed, mobile and radiolocation services, and on a secondary basis to the amateur service. The band is adjacent to the 2400-2500 MHz band which is used for industrial, scientific and medical (ISM) applications. The band is not considered appropriate for space-to-Earth MSS because of planetary research radar conducted at 2380 MHz. However, the band could be useful for MSS in the Earth-to-space direction, subject to sharing with the other primary services.

2402-2417 MHz (space-to-Earth)

This band is allocated in Region 1 on a primary basis to the fixed and mobile services, on a secondary basis to the radiolocation and amateur services and to the amateur-satellite service in accordance with RR 664. In Regions 2 and 3 , the band is allocated on a primary basis to the fixed and mobile (except aeronautical mobile) and radiolocation services and on a secondary basis to the amateur service and to the amateur-satellite service in accordance with RR 664. The band is a part of the 2400-2500 MHz band used for industrial, scientific and medical (ISM) applications. However, it may be suitable for MSS in the space-to-Earth direction, for certain types of systems.

Representatives of the amateur service have expressed objection to the allocation of the bands 2300-2310MHz, 2390-2400 MHz and 2402-2417 MHz to the Mobile-Satellite service.

3.6 Regulatory Issues

3.6.1 Introduction

Under agenda item 4 for WRC-95 it may be necessary to make certain consequential changes to the Radio Regulations. This section identifies what some of these changes may be particularly in relation to Resolution 46. This Resolution is associated with a number of 1-3 GHz MSS allocations. The items below relate to those regulatory procedures which concern Resolution 46 and its application.

3.6.2 Resolution 46 Technical and Operational Improvements

There are several constraints in Resolution 46 footnotes which relate to its application where improvements could be made. These are discussed below.

3.6.2.1 PFD Thresholds

Some Resolution 46 footnotes indicate the PFD threshold conditions under which Resolution 46 is to be applied. It is applied if the PFD thresholds of RR 2566 are exceeded. Task Group 2/2 of the ITU-R has adopted a draft Recommendation and text for the CPM which recommends different thresholds in different bands. Appropriate modifications to footnotes will need to be proposed.

3.6.2.2 E.I.R.P. Density

In RR 731E a maximum e.i.r.p. density limit is specified, but it is not indicated as to whether it is peak or average. Task Group 8/3 and Task Group 2/2 have both recommended the use of average.

3.6.3 Resolution 46 Coordination

Section II of Resolution 46 relates to spare segment coordination; Section III relates to Earth Segment coordination. Several modifications to Resolution 46 are needed to accommodate several improved coordination methods. These are intended to make the associated MSS allocations more useable.

3.6.3.1 System Specific Coordination (SSC)

In Appendix 3.8.4 is a discussion of a methodology to be used in coordination when the PFD threshold in a particular MSS 1-3 GHz allocation is exceeded. This procedure would come into effect when the PFD threshold is greater than that specified in the associated footnote. Section 2.5 of Resolution 46 then provides for identifying with which Administration coordination should take place. The Appendix describes a method which would be applied to coordinate the Non-GSO-MSS system with terrestrial systems. Task Group 2/2 has adopted a draft new Recommendation on this method and sent text to the CPM.

3.6.3.2 Coordination Region

Resolution 46, Section II outlines the procedures for assignment and coordination of the frequencies of a space station in an MSS network. Paragraph 2.1 and 2.2 specify that Administrations shall affect coordination of satellite networks and stations of terrestrial networks "where assignments might be affected." The area containing those assignments which might be affected is the coordination region.

A method to calculate the coordination region is described in the Appendix. Resolution 46 will need to be modified to accommodate it.

3.6.3.3 Coordination Area

The area currently defined in Note 1 of Section III of Resolution 46 is considered to be too large and likely to lead to unnecessary coordination. It has been concluded by Task Group 2/2, that this coordination area should be calculated using the method of Recommendation ITU-R IS 847 except for aircraft stations where a coordination distance of 500 Km and the method of ITU-R IS850 should be used.

This approach needs to be provided for in an appropriate modification of Resolution 46. Working Party 8D has produced a draft Recommendation on this method.